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**Chen**

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(54) **LIGHT SOURCE MODULE**

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*H01L 33/62* (2013.01); *H01L 2933/0091*  
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25, 2017.

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*H01L 33/60* (2010.01)  
*H01L 33/24* (2010.01)  
*H01L 33/62* (2010.01)  
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*H01L 33/58* (2010.01)

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(2013.01); *H01L 33/60* (2013.01); *H01L*

(58) **Field of Classification Search**

None

See application file for complete search history.

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

7,768,754 B2 \* 8/2010 Collins, III ..... *H01C 7/12*  
257/100  
8,471,280 B2 \* 6/2013 Aldaz ..... *H01L 33/60*  
257/98  
9,006,005 B2 \* 4/2015 Han ..... *H01L 33/62*  
257/433  
9,105,814 B2 \* 8/2015 Hwan ..... *H01L 24/17*  
2010/0109025 A1 \* 5/2010 Bhat ..... *H01L 24/97*  
257/88

(Continued)

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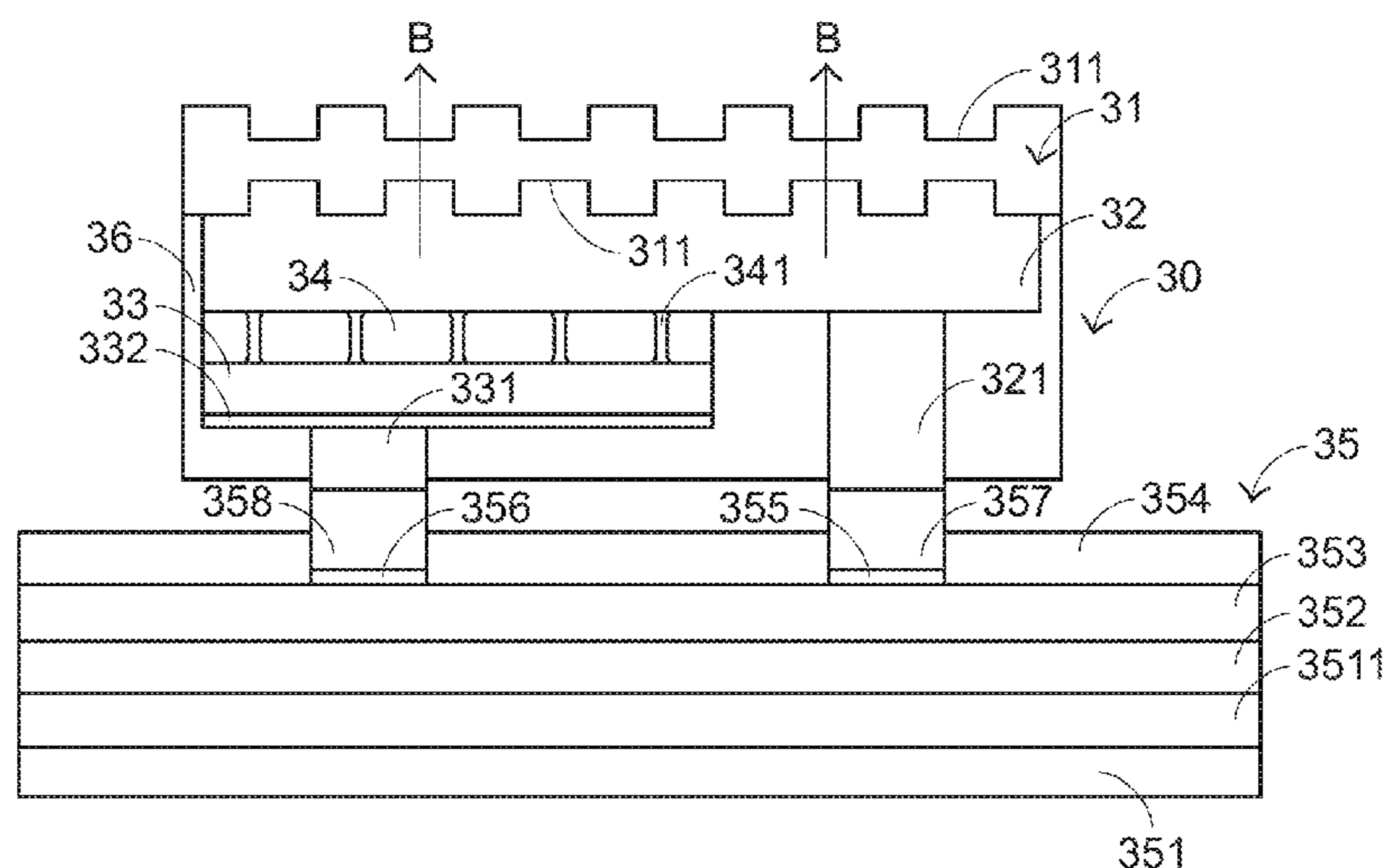
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(57) **ABSTRACT**

A light source module includes a substrate, a first covering layer, a second covering layer, a luminous layer and a supporting base. The luminous layer is arranged between the first covering layer and the second covering layer. The luminous layer emits a light beam in response to a first current flowing through the first covering layer and a second current flowing through the second covering layer. The light beam is projected to surroundings through the substrate. The supporting base is electrically connected with the first covering layer and the second covering layer. The supporting base includes a circuit board and a passivation layer. When a portion of the light beam projected to the supporting base is reflected by the passivation layer, the portion of the light beam is projected to the surroundings through the substrate.

**10 Claims, 5 Drawing Sheets**

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## References Cited

2011/0294242	A1 *	12/2011	Lu .....	H01L 33/20	438/27
2016/0018078	A1 *	1/2016	Katoh .....	H01L 33/60	362/296.04
2016/0351767	A1 *	12/2016	Choi .....	H01L 33/62	
2017/0179352	A1 *	6/2017	Song .....	H01L 33/486	

\* cited by examiner

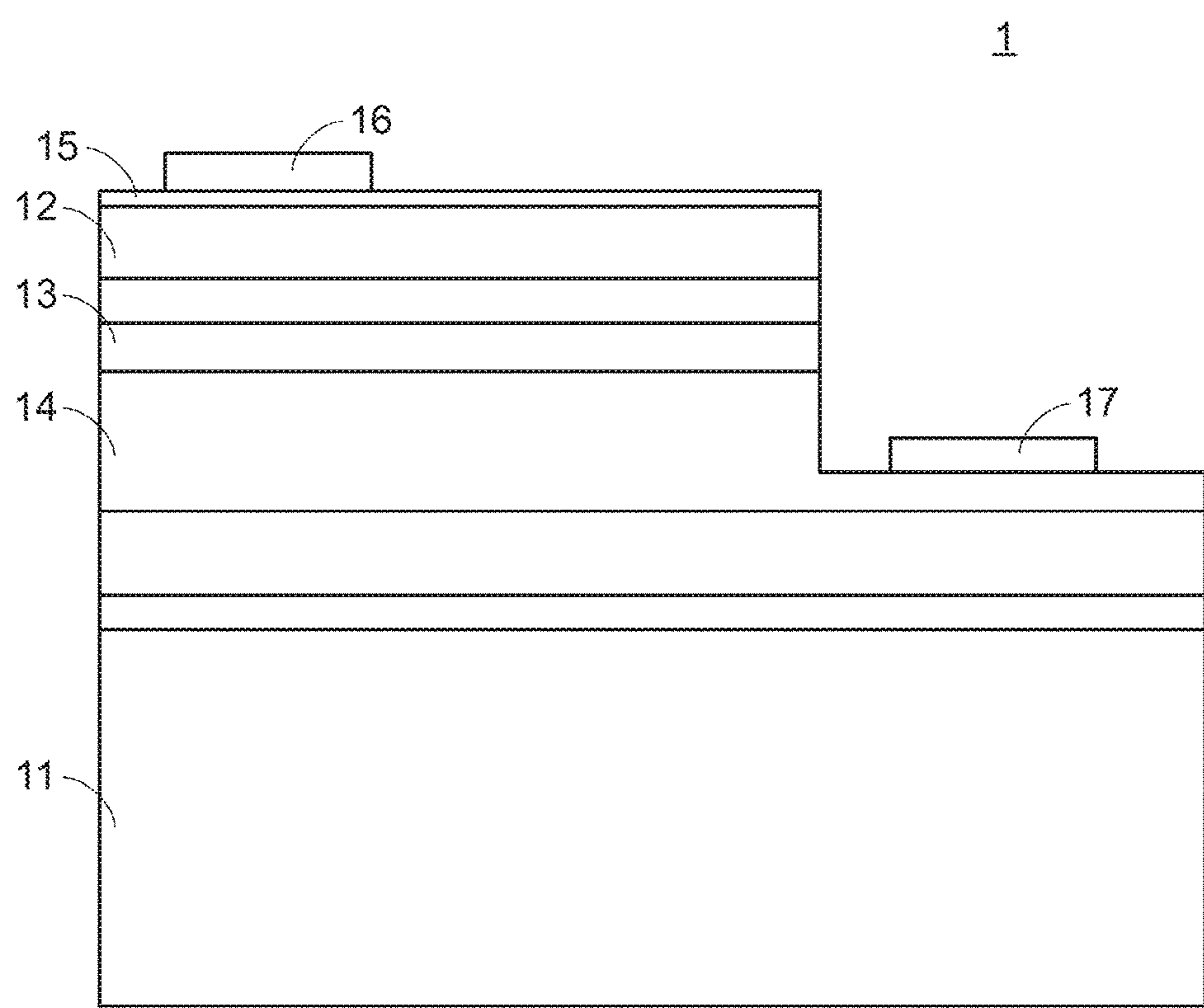


FIG.1  
PRIOR ART

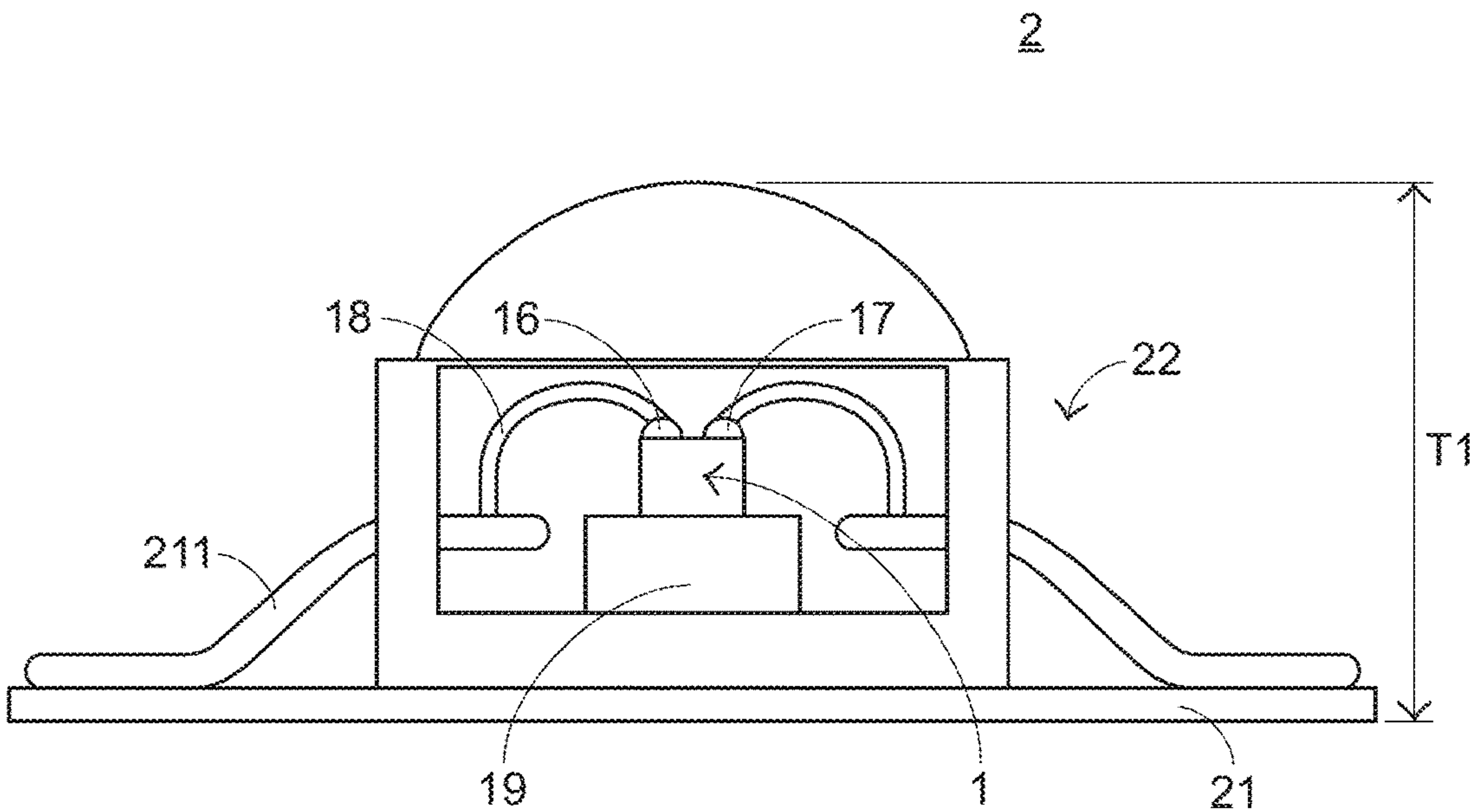
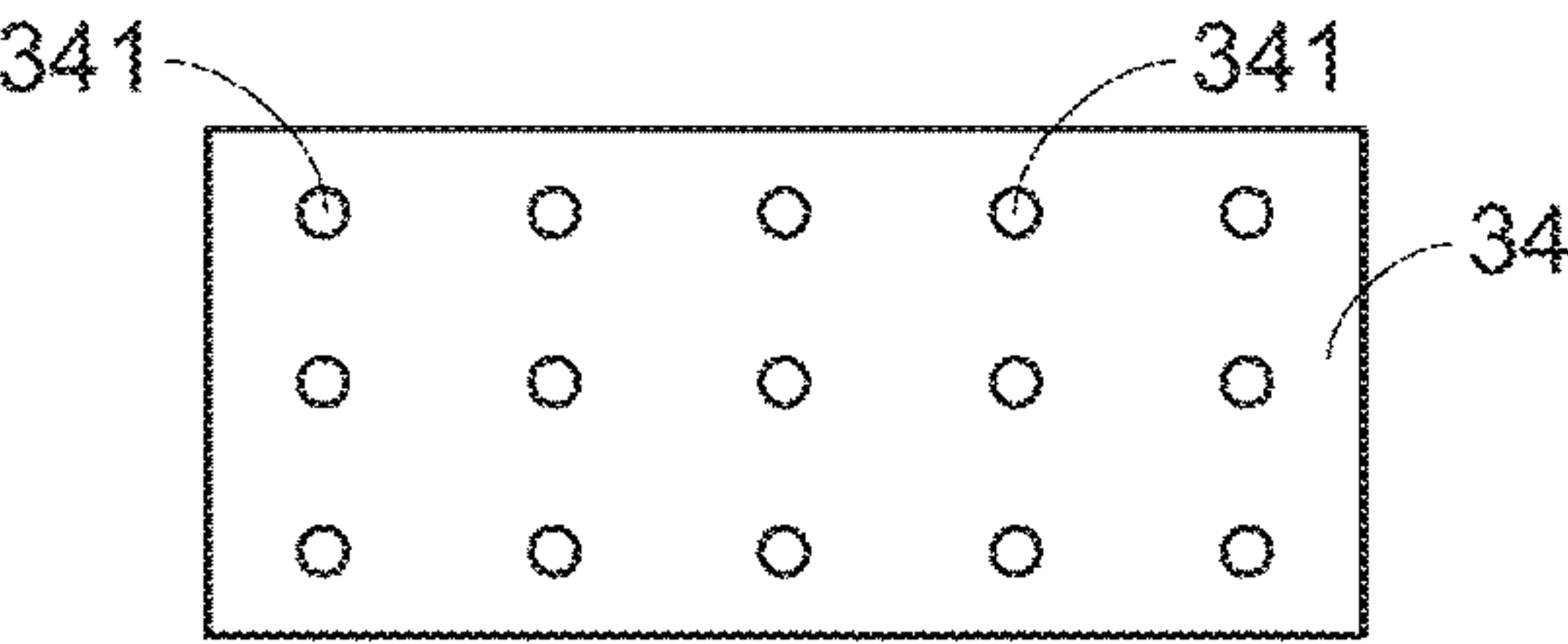
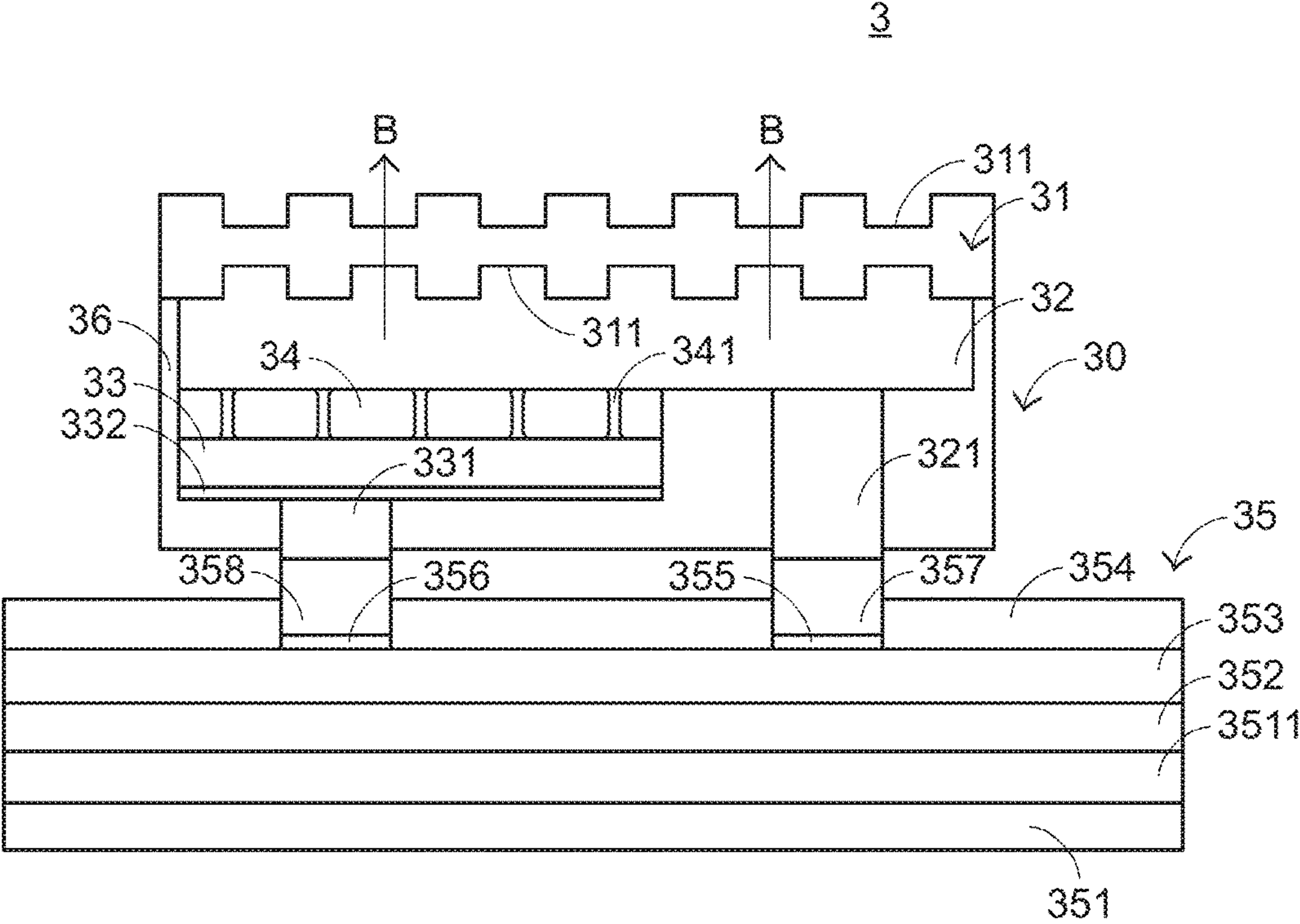


FIG.2  
PRIOR ART



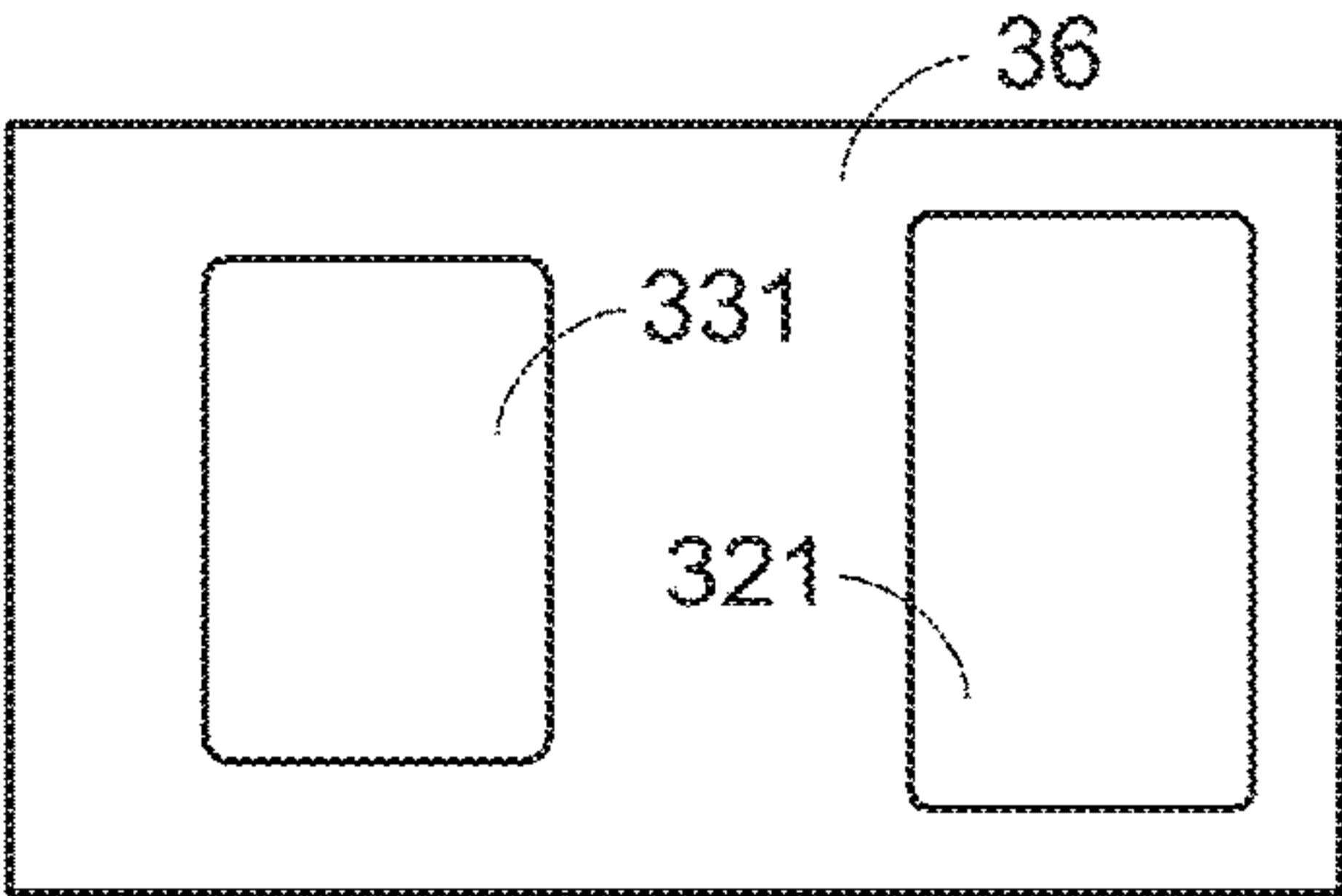


FIG.5

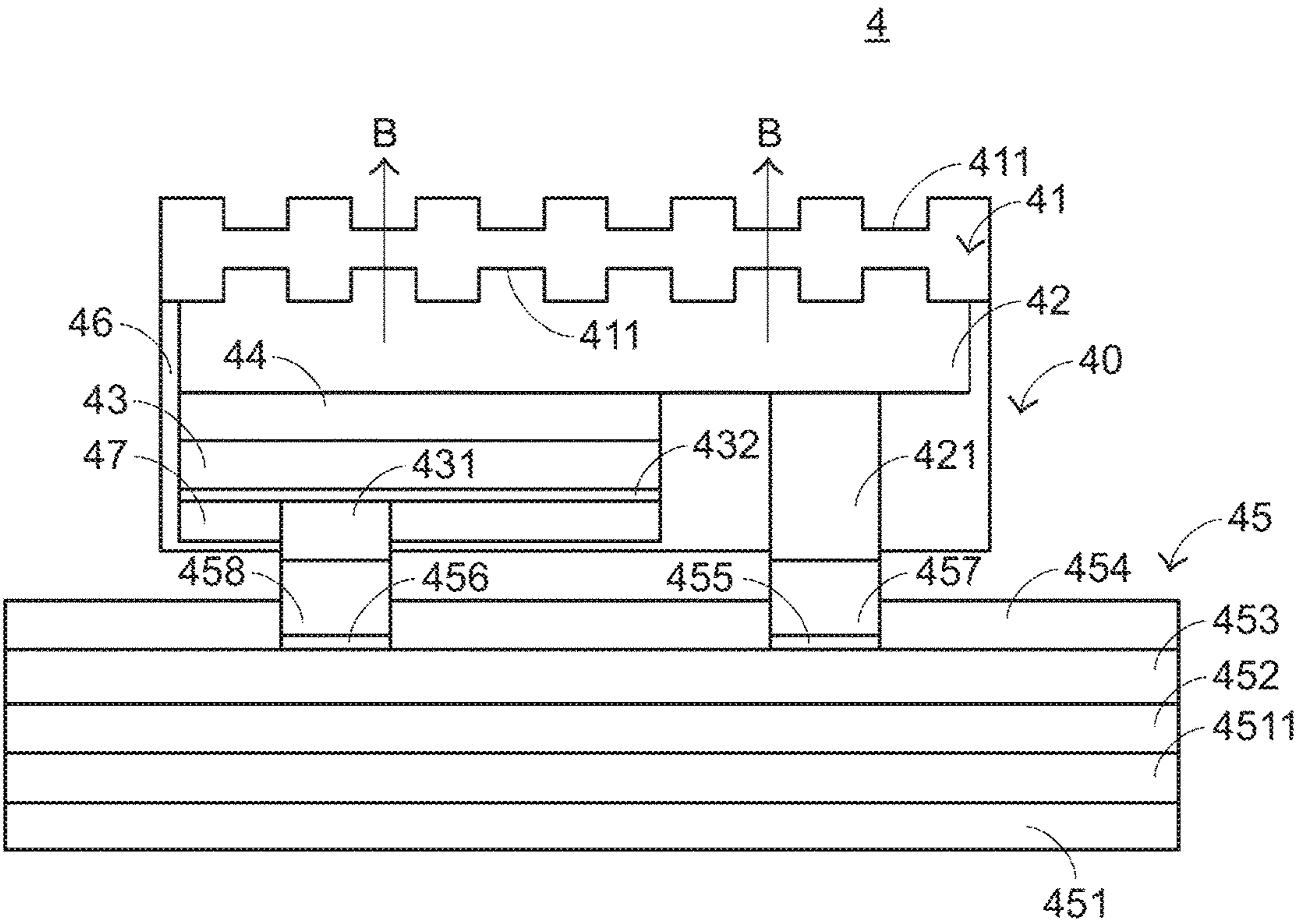


FIG.6



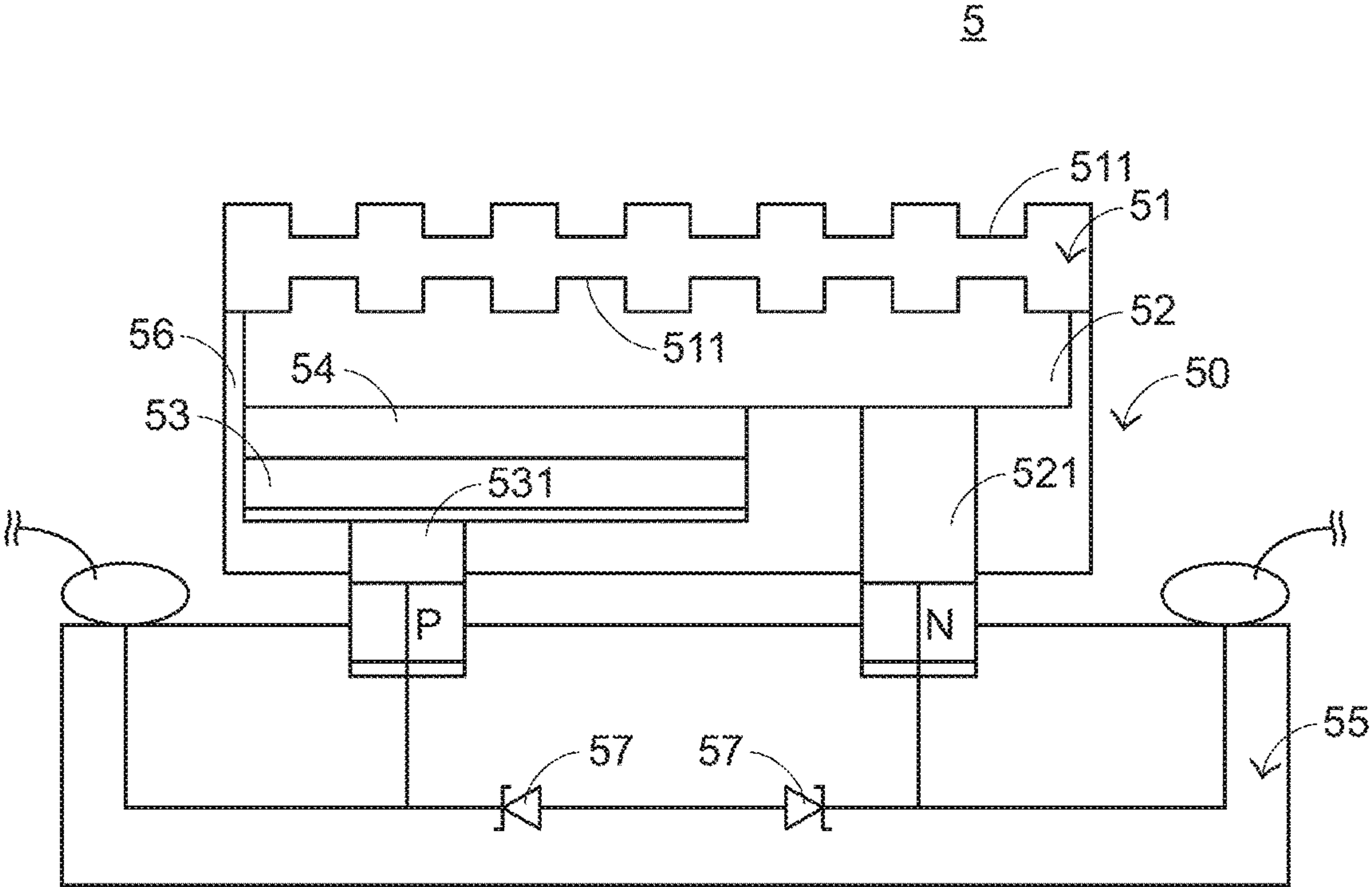


FIG.7

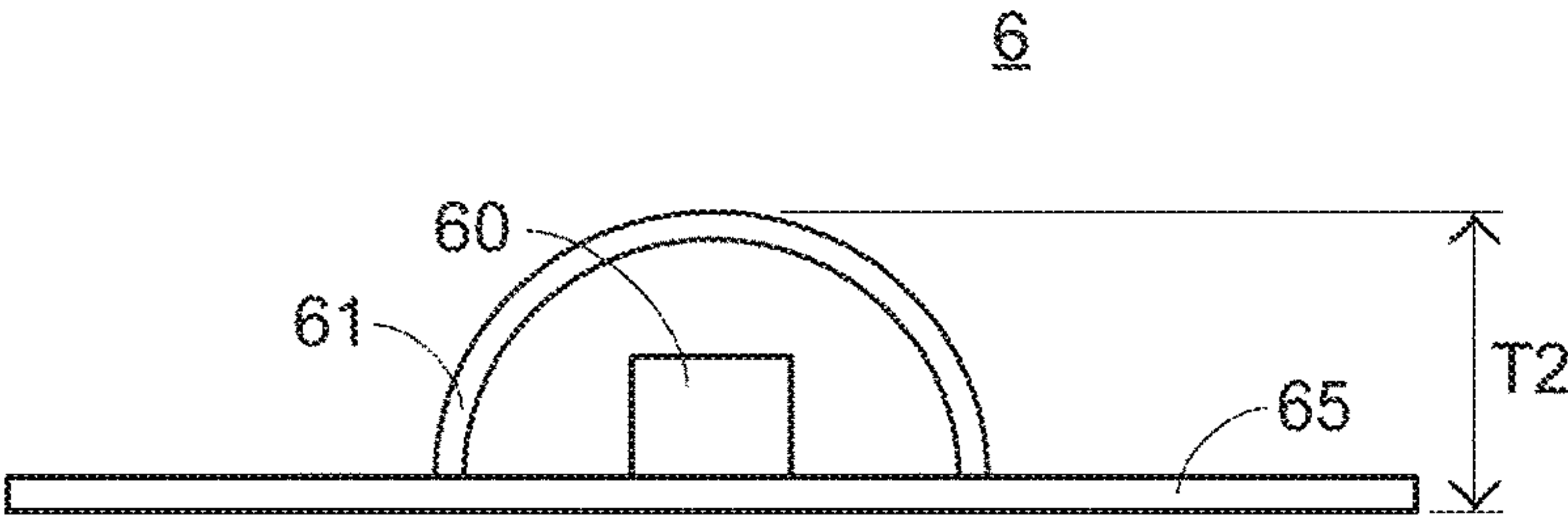


FIG.8

## 1

## LIGHT SOURCE MODULE

CROSS-REFERENCE TO RELATED  
APPLICATION

This application claims priority to U.S. Provisional Patent Application No. 62/562,595 filed Sep. 25, 2017, the contents of which are incorporated herein by reference.

## FIELD OF THE INVENTION

The present invention relates to a light source module, and more particularly to a light source module with high luminous efficiency.

## BACKGROUND OF THE INVENTION

Generally, a common light source uses a light emitting diode (LED) to generate a light beam. The illuminating principle of the light emitting diode will be described as follows. When a current is applied to a semiconductor material of Group III-V such as gallium nitride (GaN), gallium phosphide (GaP), gallium arsenide (GaAs) or indium phosphide (InP), electrons recombine with holes. Consequently, the extra energy is released from a multiple quantum well (MQW) in the form of photons, and the light beam visible to the eyes is generated.

The structure of a conventional LED die will be described as follows. FIG. 1 is a schematic cross-sectional view illustrating the structure of a conventional LED die. As shown in FIG. 1, the conventional LED die 1 has a multi-layered stack structure comprising a substrate 11, a P-type covering layer 12, a multiple quantum well 13, an N-type covering layer 14, a conducting film layer 15 (e.g., an ITO layer), a P-type electrode 16 and an N-type electrode 17. The P-type electrode 16 and the N-type electrode 17 are disposed on the top surface of the LED die 1. The P-type electrode 16 and the N-type electrode 17 are connected with wires according to a wire bonding process, which will be described later. The multiple quantum well 13 is disposed within the multi-layered stack structure. As mentioned above, the light beam of the LED die 1 is outputted from the multiple quantum well 13. Since the light beam is outputted upwardly from the multiple quantum well 13, a portion of the light beam is blocked and lost by the P-type covering layer 12, the conducting film layer 15, the P-type electrode 16 and the N-type electrode 17. Consequently, the overall luminous efficiency of the conventional LED die 1 to output the light beam upwardly is adversely affected. Generally, the overall luminance of the conventional LED die 1 is mainly dependent on the portion of the light beam leaked from the lateral side of the multiple quantum well 13. Consequently, the luminous efficiency of the conventional LED die 1 is not satisfied. In other words, the luminous efficiency of the conventional LED die 1 needs to be further improved.

FIG. 2 is a schematic cross-sectional view illustrating a light source module with the conventional LED die. The light source module 2 comprises a circuit board 21 and plural LED elements 22. The plural LED elements 22 are installed on the circuit board 21. For succinctness, only one LED element 22 is shown in FIG. 2. Each LED element 22 is electrically connected with the circuit board 21 to receive the current from the circuit board 21. Consequently, the LED element 22 emits a light beam. The light source module is installed within an electronic device (not shown). Consequently, the electronic device has the function of outputting the light beam.

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Generally, there are two types of light source modules. In the first type light source module, the circuit board 21 has a circuitry for controlling the operation of the LED element 22, and the electronic function of the electronic device to process associated electronic signals is implemented by another circuit board. In the second type light source module, the circuit board 21 has a circuitry for controlling the operation of the LED element 22, and the electronic function of the electronic device to process associated electronic signals is also implemented by the circuit board 21.

In the light source module 2, the LED element 22 is a package structure of a single LED die 1. In addition, the P-type electrode 16 and the N-type electrode 17 of the LED die 1 are connected with corresponding pins 211 of the circuit board 21 through wires 18. Consequently, the LED element 22 can receive the current from the circuit board 21. However, during the process of packaging the LED die 1, the LED die 1 is usually installed on a carrier plate 19. The volume of the carrier plate 19 and the retained height of the wires 18 are the main factors that increase the overall thickness of the package structure of the LED die 1. In other words, it is difficult to reduce the thickness of the light source module with the LED die 1. Of course, the increased thickness of the package structure of the LED die 1 is detrimental to the development of the electronic device toward small size and light weightiness.

As mentioned above, the conventional light source module needs to be further improved. Therefore, there is a need of providing a light source module with reduced thickness and enhanced luminous efficiency.

## SUMMARY OF THE INVENTION

The present invention provides a light source module with reduced thickness and enhanced luminous efficiency.

In accordance with an aspect of the present invention, there is provided a light source module. The light source module includes a substrate, a first covering layer, a second covering layer, a luminous layer and a supporting base. The first covering layer is disposed on a bottom surface of the substrate. A first current flows through the first covering layer. The second covering layer is located under the first covering layer. A second current flows through the second covering layer. The luminous layer is arranged between the first covering layer and the second covering layer. The luminous layer emits a light beam in response to the first current and the second current. The light beam is projected to surroundings through the substrate. The supporting base is electrically connected with the first covering layer and the second covering layer, and includes a circuit board, a first metal connection layer, a second metal connection layer and a passivation layer. The first metal connection layer is disposed on a top surface of the circuit board. A second metal connection layer is disposed on the first metal connection layer. The second metal connection layer and the first metal connection layer are combined together to reflect the light beam. The passivation layer is disposed on the second metal connection layer to protect the circuit board. The first metal connection layer and the second metal connection layer. When a portion of the light beam projected to the supporting base is reflected by the passivation layer, the portion of the light beam is projected to the surroundings through the substrate.

In an embodiment, the light source module further includes a reflecting layer. The reflecting layer is disposed on a bottom surface of the second covering layer. When a portion of the light beam transmitted through the second



covering layer is reflected by the reflecting layer, the portion of the light beam is projected to the surroundings through the substrate.

The above objects and advantages of the present invention will become more readily apparent to those ordinarily skilled in the art after reviewing the following detailed description and accompanying drawings, in which:

#### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic cross-sectional view illustrating the structure of a conventional LED die;

FIG. 2 is a schematic cross-sectional view illustrating a light source module with the conventional LED die;

FIG. 3 is a schematic cross-sectional view illustrating a light source module according to a first embodiment of the present invention;

FIG. 4 is a schematic top view illustrating the luminous layer of the light source module according to the first embodiment of the present invention;

FIG. 5 is a schematic bottom view illustrating a portion of the light source module according to the first embodiment of the present invention;

FIG. 6 is a schematic cross-sectional view illustrating a light source module according to a second embodiment of the present invention;

FIG. 7 is a schematic cross-sectional view illustrating a light source module according to a third embodiment of the present invention; and

FIG. 8 is a schematic cross-sectional view illustrating a light source module according to a fourth embodiment of the present invention after being packaged.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

For solving the drawbacks of the conventional technologies, the present invention provides a light source module.

FIG. 3 is a schematic cross-sectional view illustrating a light source module according to a first embodiment of the present invention. As shown in FIG. 3, the light source module 3 comprises a substrate 31, a first covering layer 32, a second covering layer 33, a luminous layer 34, a supporting base 35 and a first passivation layer 36. The first covering layer 32 is disposed on the bottom surface of the substrate 31 for allowing a first current to go through. The second covering layer 33 is located under the first covering layer 32 for allowing a second current to go through. The luminous layer 34 is arranged between the first covering layer 32 and the second covering layer 33. In response to the first current and the second current, the luminous layer 34 emits a light beam B. After the light beam B is transmitted through the substrate 31, the light beam B is projected to the surroundings. The first covering layer 32, the second covering layer 33 and the luminous layer 34 are stack structures that are formed of semiconductor material of Group III-V. In addition, electrons recombine with holes, and the extra energy is released in the form of light. In an embodiment, the first covering layer 32 is an N-GaN covering layer, the second covering layer 33 is a P-GaN covering layer, and the luminous layer 34 is a multiple quantum well.

Please refer to FIGS. 3 and 4. FIG. 4 is a schematic top view illustrating the luminous layer of the light source module according to the first embodiment of the present invention. The luminous layer 34 comprises plural openings 341. The plural openings 341 are uniformly distributed in the luminous layer 34. Moreover, the plural openings 341

run through the top surface of the luminous layer 34 and the bottom surface of the luminous layer 34. Since the plural openings 341 are uniformly distributed, the density of the first current and the density of the second current are more uniform. Consequently, the light beam B is uniformly outputted from the luminous layer 34.

The substrate 31 comprises plural microstructures 311, which are formed on the top surface and the bottom surface of the substrate 31. Due to the microstructures 311, the total internal reflection of the light beam B within the substrate 31 will be avoided. In other words, the arrangement of the microstructures 311 can facilitate projecting the light beam B to the surroundings through the substrate 31. In this embodiment, the microstructures 311 are formed on the top surface and the bottom surface of the substrate 31 by using any other appropriate method (e.g., an etching process). Moreover, the first covering layer 32 comprises a first contact pad 321, and the second covering layer 33 comprises a second contact pad 331. The first contact pad 321 is disposed on the bottom surface of the first covering layer 32 and electrically connected with the first covering layer 32. The second contact pad 331 is disposed on the bottom surface of the second covering layer 33 and electrically connected with the second covering layer 33. Preferably, the second covering layer 33 further comprises a transparent conductive layer 332. The transparent conductive layer 332 is disposed on the bottom surface of the second covering layer 33 for assisting in the electric conduction of the second covering layer 33.

In this embodiment, a LED die 30 is defined by the substrate 31, the first covering layer 32, the second covering layer 33, the luminous layer 34 and the first passivation layer 36 collaboratively. After the LED die 30 and the supporting base 35 are combined together, the light source module 3 is produced.

Please refer to FIG. 3 again. The supporting base 35 is electrically connected with the first covering layer 32, the second covering layer 33. In addition, the supporting base 35 comprises a circuit board 351, a first metal connection layer 352, a second metal connection layer 353, a second passivation layer 354, a first electrode 355, a second electrode 356, a first metallic coupling block 357 and a second metallic coupling block 358. The first metal connection layer 352 is disposed on the top surface of the circuit board 351. The second metal connection layer 353 is disposed on the first metal connection layer 352. The second metal connection layer 353 and the first metal connection layer 352 are combined together to reflect the light beam B. The second passivation layer 354 is disposed on the second metal connection layer 353 for protecting the circuit board 351, the first metal connection layer 352 and the second metal connection layer 353. In addition, the portion of the light beam B projected to the supporting base 35 can be reflected by the second passivation layer 354. Consequently, the light beam B is projected to the surroundings through the substrate 31. The first electrode 355 is disposed on the second metal connection layer 353. The second electrode 356 is also disposed on the second metal connection layer 353. The first metallic coupling block 357 is disposed on the first electrode 355. Moreover, the first electrode 355 and the first contact pad 321 of the first covering layer 32 are combined with each other through the first metallic coupling block 357. Similarly, the second metallic coupling block 358 is disposed on the second electrode 356. Moreover, the second electrode 356 and the second contact pad 331 of the second covering layer 33 are combined with each other through the second metallic coupling block 358. In other words, the



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supporting base **35** is electrically connected with the first covering layer **32** and the second covering layer **33** through the first metallic coupling block **357** and the second metallic coupling block **358**, respectively.

As shown in FIG. 3, the substrate **31**, the first contact pad **321** and the second contact pad **331** are exposed outside the first covering layer **32**, the second covering layer **33** and the luminous layer **34**. The first contact pad **321** and the second contact pad **331** are fixed on the supporting base **35** or the conventional carrier plate **19** through a direct coupling process (e.g., a welding process or any other appropriate coupling process). That is, the electric connection of the light source module **3** is established without the need of performing the wire boning process. Consequently, the overall thickness of the light source module **3** is reduced. The reduction of the thickness is helpful to achieve the slimness benefit of the light source module **3**. Moreover, the first covering layer **32**, the first contact pad **321**, the second covering layer **33**, the second contact pad **331** and the luminous layer **34** are covered by the first passivation layer **36**. Consequently, these components are protected by the first passivation layer **36**.

The first contact pad **321** is electrically connected with the first electrode **355** through the first metallic coupling block **357**. The second contact pad **331** is electrically connected with the second electrode **356** through the second metallic coupling block **358**. Consequently, the wire bonding process is omitted. Moreover, the heat generated by the first contact pad **321** and the second contact pad **331** is directly transferred to the underlying supporting base **35** through thermal conduction. Moreover, the heat is dissipated to the surroundings through the supporting base **35**. Since the supporting base **35** has a large area, the heat can be dissipated away more quickly. Since the heat is largely reduced, the loss of the luminous efficiency of the light source is reduced.

In an embodiment, the circuit board **351** is made of gold or silver to increase the electrical property and the scattering property. Preferably but not exclusively, the circuit board **351** is a flexible printed circuit board (FPC), a printed circuit board (PCB) or a copper plated resin board (PET). The flexible printed circuit board is formed by coating copper traces on a polyimide base (i.e., a PI base) and then performing a surface treatment. The printed circuit board is formed by coating copper traces on a fiberglass reinforced epoxy resin base (i.e., FR4 base) and then performing a surface treatment. The copper plated resin board is formed by coating copper traces on a polyethylene terephthalate base (i.e., PET base) and then performing a surface treatment.

In an embodiment, the first metallic coupling block **357** and the second metallic coupling block **358** are soldering material such as solder paste, silver paste, gold ball, solder ball or tin paste. The welding process includes but is not limited to a thermosonic process, a eutectic process or a reflow process. The first metal connection layer **352** is made of copper or a copper-like metallic material. The second metal connection layer **353** is made of gold, nickel, a gold-like metallic material or a nickel-like metallic material. Due to the properties of gold or nickel, the second metal connection layer **353** provides higher reflectivity and higher bonding capability.

The following four aspects should be specially described.

Firstly, a copper foil **3511** is disposed on the top surface of the circuit board **351**. Consequently, the top surface of the circuit board **351** is not smooth. After the first metal connection layer **352** is formed on the top surface of the circuit board **351**, the top surface of the circuit board **351** is smooth.

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Secondly, the materials of the first metallic coupling block **357** and the second metallic coupling block **358** are not restricted as long as they are made of conductive metallic materials. That is, the first metallic coupling block **357** is not restrictedly made of copper, and the second metallic coupling block **358** is not restrictedly made of gold or nickel.

Thirdly, in a preferred embodiment, the substrate **31** is a transparent or translucent sapphire substrate. Consequently, the light beam B generated by the luminous layer **34** is transmitted upwardly through the substrate **31** without being blocked. In other words, the number of times the light beam is reflected and the light loss percentage will be reduced, and the luminous efficiency will be enhanced. Moreover, due to this arrangement, the overall light-outputting area of the light source module **3** is increased. Moreover, since the substrate **31** comprises the concave-convex microstructures **311**, the light beam B generated by the light source module **3** will not undergo the total internal reflection within the substrate **31**. Consequently, the light beam B can be directly projected to the surroundings through the substrate **31**. Under this circumstance, the light-outputting efficiency of the light source module **3** is enhanced. The experiments indicate that the light-outputting efficiency of the light source module **3** is 1.6~3 times the light-outputting efficiency of the conventional light source module.

Fourthly, the second passivation layer **354** of the supporting base **35** is made of an insulating material, and the second metal connection layer **353**, the first electrode **355** and the second electrode **356** are covered by the second passivation layer **354**. Consequently, the junction between the first contact pad **321** and the first metallic coupling block **357** and the junction between the second contact pad **331** and the second metallic coupling block **358** will not generate the leakage current. Moreover, the second passivation layer **354** has the reflecting function. The portion of the light beam B that is projected downwardly will be reflected by the second passivation layer **354**. Consequently, the light utilization efficiency is enhanced. In an embodiment, the second passivation layer **354** is an integral structure of an insulating material and a reflecting material. Alternatively, the insulating material and the reflecting material are separately formed as the second passivation layer **354**.

Please refer to FIGS. 3 and 5. FIG. 5 is a schematic bottom view illustrating a portion of the light source module according to the first embodiment of the present invention. As shown in FIG. 3, the bottom of the first contact pad **321** and the bottom surface of the second contact pad **331** are at the same level so as to facilitate combining the first contact pad **321** and the second contact pad **331** with the supporting base **35**. Moreover, a portion of the LED die **30** of the light source module **3** is shown in FIG. 5. As shown in FIG. 5, the areas of the first contact pad **321** and the second contact pad **331** occupy a large percentage of the bottom surface of the first passivation layer **36**. The large areas of the first contact pad **321** and the second contact pad **331** are helpful for transferring the heat from the LED die **30** to the supporting base **35** through thermal conduction. Since the light source module **3** is not overheated, the luminous efficiency is not deteriorated.

The present invention further provides a second embodiment, which is distinguished from the first embodiment. FIG. 6 is a schematic cross-sectional view illustrating a light source module according to a second embodiment of the present invention. As shown in FIG. 6, the light source module **4** comprises a substrate **41**, a first covering layer **42**, a second covering layer **43**, a luminous layer **44**, a supporting base **45**, a first passivation layer **46** and a reflecting layer



47. The substrate 41 comprises plural microstructures 411. The first covering layer 42 comprises a first contact pad 421. The second covering layer 43 comprises a second contact pad 431 and a transparent conductive layer 432. The supporting base 45 comprises a circuit board 451, a first metal connection layer 452, a second metal connection layer 453, a second passivation layer 454, a first electrode 455, a second electrode 456, a first metallic coupling block 457 and a second metallic coupling block 458. In this embodiment, a LED die 40 is defined by the substrate 41, the first covering layer 42, the second covering layer 43, the luminous layer 44 and the first passivation layer 46 collaboratively. After the LED die 40 and the supporting base 45 are combined together, the light source module 4 is produced. In comparison with the first embodiment, the light source module 4 further comprises the reflecting layer 47. The structures and functions of the other components of the light source module 4 are similar to those of the first embodiment, and are not redundantly described herein.

The reflecting layer 47 is disposed on the bottom surface of the second covering layer 43. The portion of the light beam B transmitted through the second covering layer 43 can be reflected by the reflecting layer 47. Consequently, the light beam B is projected to the surroundings through the substrate 41, and the light utilization efficiency is enhanced. In case that the second covering layer 43 comprises the transparent conductive layer 432, the reflecting layer 47 is disposed on the bottom surface of the transparent conductive layer 432. In other words, the light source module of this embodiment is equipped with a distributed Bragg reflector (DBR) between the luminous layer 44 and the supporting base 45. Consequently, the light-outputting efficiency of the light source module of this embodiment is increased when compared with the conventional light source module.

The present invention further provides a third embodiment, which is distinguished from the above embodiments. FIG. 7 is a schematic cross-sectional view illustrating a light source module according to a third embodiment of the present invention. As shown in FIG. 7, the light source module 5 comprises a substrate 51, a first covering layer 52, a second covering layer 53, a luminous layer 54, a supporting base 55, a first passivation layer 56 and plural Zener diodes 57. The substrate 51 comprises plural microstructures 511. The first covering layer 52 comprises a first contact pad 521. The second covering layer 53 comprises a second contact pad 531 and a transparent conductive layer 532. In this embodiment, a LED die 50 is defined by the substrate 51, the first covering layer 52, the second covering layer 53, the luminous layer 54 and the first passivation layer 56 collaboratively. After the LED die 50 and the supporting base 55 are combined together, the light source module 5 is produced. In comparison with the above embodiments, the light source module 5 further comprises the plural Zener diodes 57. The plural Zener diodes 57 are disposed on the supporting base 55. Moreover, the Zener diodes 57 and the luminous layer 54 are in inverse-parallel connection to form an electrostatic discharge (ESD) protection circuit. Consequently, the light source module is protected. The structures and functions of the other components of the light source module 5 are similar to those of the above embodiments, and are not redundantly described herein.

FIG. 8 is a schematic cross-sectional view illustrating a light source module according to a fourth embodiment of the present invention after being packaged. As shown in FIG. 8, the LED die 60 is disposed on a supporting base 65. In addition, a protective glue 61 is sprayed on the LED die 60 and the supporting base 65. The process of spraying the

protective glue 61 is similar to the packaging process in order to protect the LED die 60. In this embodiment, the LED die 60 is defined by the substrate, the first covering layer, the second covering layer, the luminous layer and the first passivation layer collaboratively. After the LED die 60 and the supporting base 65 are combined together, the light source module 6 is produced.

Please refer to FIG. 2 again. According to the conventional technology of installing the light source on the circuit board 21, the LED element 22 (i.e., the package structure of the LED die 1) is placed on the circuit board 21, and the LED element 22 and the circuit board 21 are connected with each other through wires 18 so as to form the light source module 2. The light source module 2 has a thickness T1. According to the present invention, the constituents of the LED die 60 are modified. Consequently, the LED die 60 is directly welded on the supporting base 65 without the need of using the wire bonding process. That is, the packaging process (e.g., the process of spraying the protective glue 61) can be simply performed to produce the light source module 6. As shown in FIG. 7, the light source module 6 has a thickness T2. As mentioned above, the LED die 60 of the present invention is distinguished from the conventional LED die 1. Since the thickness T2 of the light source module 6 is much smaller than the thickness T1 of the light source module 2, the thickness of the light source module of the present invention is effectively reduced.

While the invention has been described in terms of what is presently considered to be the most practical and preferred embodiments, it is to be understood that the invention needs not be limited to the disclosed embodiment. On the contrary, it is intended to cover various modifications and similar arrangements included within the spirit and scope of the appended claims which are to be accorded with the broadest interpretation so as to encompass all such modifications and similar structures.

What is claimed is:

1. A light source module, comprising:

- a substrate;
- a first covering layer disposed on a bottom surface of the substrate, wherein a first current flows through the first covering layer;
- a second covering layer located under the first covering layer, wherein a second current flows through the second covering layer;
- a luminous layer arranged between the first covering layer and the second covering layer, wherein the luminous layer emits a light beam in response to the first current and the second current, and the light beam is projected to surroundings through the substrate; and
- a supporting base electrically connected with the first covering layer and the second covering layer, and comprising a circuit board, a first metal connection layer, a second metal connection layer and a passivation layer, wherein the first metal connection layer is disposed on a top surface of the circuit board, the second metal connection layer is disposed on the first metal connection layer, the second metal connection layer and the first metal connection layer are combined together to reflect the light beam, and the passivation layer is disposed on the second metal connection layer to protect the circuit board, the first metal connection layer and the second metal connection layer, wherein when a portion of the light beam projected to the supporting base is reflected by the passivation layer, the portion of the light beam is projected to the surroundings through the substrate.



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2. The light source module according to claim 1, wherein the first covering layer comprises a first contact pad, and the second covering layer comprises a second contact pad, wherein the first contact pad is disposed on a bottom surface of the first covering layer and electrically connected with the first covering layer, and the second contact pad is disposed on a bottom surface of the second covering layer and electrically connected with the second covering layer.

3. The light source module according to claim 2, wherein the supporting base further comprises:

a first electrode disposed on the second metal connection layer;

a second electrode disposed on the second metal connection layer;

a first metallic coupling block disposed on the first electrode, wherein the first electrode and the first contact pad are combined with each other through the first metallic coupling block; and

a second metallic coupling block disposed on the second electrode, wherein the second electrode and the second contact pad are combined with each other through the second metallic coupling block.

4. The light source module according to claim 3, wherein the first metallic coupling block is made of solder paste, silver paste, gold ball, solder ball or tin paste, and the second metallic coupling block is made of solder paste, silver paste, gold ball, solder ball or tin paste.

5. The light source module according to claim 1, wherein the first metal connection layer is made of copper or a

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copper-like metallic material, and the second metal connection layer is made of gold, nickel, a gold-like metallic material or a nickel-like metallic material.

6. The light source module according to claim 1, wherein the substrate comprises plural microstructures, wherein the plural microstructures are disposed on a top surface and the bottom surface of the substrate to avoid total internal reflection of the light beam so as to facilitate projecting the light beam to the surroundings.

7. The light source module according to claim 1, wherein the substrate is a sapphire substrate.

8. The light source module according to claim 1, wherein the luminous layer is a multiple quantum well.

9. The light source module according to claim 1, wherein the second covering layer further comprises a transparent conductive layer, wherein the transparent conductive layer is disposed on a bottom surface of the second covering layer for assisting in electric conduction of the second covering layer.

10. The light source module according to claim 1, wherein the light source module further comprises a reflecting layer, which is disposed on a bottom surface of the second covering layer, wherein when a portion of the light beam transmitted through the second covering layer is reflected by the reflecting layer, the portion of the light beam is projected to the surroundings through the substrate.

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